

WHAT IS CLAIMED IS:

1. A method of forming a cementitious material, comprising:
preparing a formulation comprising a cementitious binder and aggregate;
adding to the formulation a quantity of low density calcium silicate hydrate sufficient to reduce the curing time of the formulation as compared to an equivalent formulation without calcium silicate hydrate; and
curing the formulation for a time sufficient to cause the material to set;
wherein the formulation sets in a period of time that is at least 10% less than the time it would take an equivalent formulation without calcium silicate hydrate to set.
2. The method of Claim 1, wherein the formulation sets in a period of time that is at least 20% less than the time it would take an equivalent formulation without calcium silicate hydrate to set.
3. The method of Claim 1, wherein the low-density calcium silicate hydrate has a bulk density of between about 0.015 g/cm³ and 1.5 g/cm³.
4. The method of Claim 1, wherein the cementitious material comprises sufficient low-density calcium silicate hydrate to produce a cured product of density between about 0.6 g/cm³ and 1.2 g/cm³.
5. The method of Claim 1, comprising forming the material using the Hatschek production process.
6. The method of Claim 5, wherein preparing the formulation comprises mixing a slurry of cellulose fiber pulp with a slurry of silica to form a mixture, and adding cement to the mixture.
7. The method of Claim 6, wherein the calcium silicate hydrate is added as a slurry to the mixture.
8. The method of Claim 6, wherein the calcium silicate hydrate is added in dry form to the mixture.
9. The method of Claim 6, further comprising adding additional aggregates and additives to the mixture.

10. The method of Claim 1, comprising forming the material into articles for building and construction applications.

11. The method of Claim 10, wherein the material is formed into a concrete article.

12. The method of Claim 11, wherein preparing the formulation comprises making a mixture by adding cement, silica and aggregate into a mixing machine and dry mixing the mixture.

13. The method of Claim 12, further comprising adding fiber reinforcement to the mixture.

14. The method of Claim 13, wherein the fiber reinforcement is selected from the group consisting of steel wire, steel rods, poly-fiber and carbon fiber.

15. The method of Claim 12, wherein the silica is quartz sand.

16. The method of Claim 12, wherein the aggregate is selected from the group consisting of natural rock, sand, gravel, limestone and bottom ash.

17. The method of Claim 12, further comprising adding water to the mixture and mixing the mixture.

18. The method of Claim 17, wherein adding the calcium silicate hydrate accelerant to the formulation occurs after mixing the mixture with water.

19. The method of Claim 18, further comprising mixing the mixture having calcium silicate hydrate.

20. The method of Claim 11, wherein the low-density calcium silicate hydrate accelerant is added to the cementitious mixture after the cementitious mixture has been transported to its place of intended use

21. The method of Claim 1, wherein the formulation is formed into a green article by extrusion.

22. The method of Claim 21, wherein preparing the formulation comprises making a mixture by adding cement, silica, and fibers into a mixing machine, and dry mixing the mixture.

23. The method of Claim 22, wherein the formulation further comprises a siliceous aggregate in addition to the silica.

24. The method of Claim 21, wherein the fibers are selected from the group consisting of cellulose fibers, synthetic polymer fibers, and a combination of both.

25. The method of Claim 21, further comprising adding organic admixtures to the mixture.

26. The method of Claim 22, further comprising adding water to the mixture, and mixing the mixture with the water.

27. The method of Claim 26, wherein the calcium silicate hydrate is added to the mixture in dry form before adding water, and the calcium silicate hydrate is dry mixed with the mixture.

28. The method of Claim 22, wherein the calcium silicate hydrate is added to the mixture in slurry form after dry mixing the mixture.

29. The method of Claim 26, further comprising discharging the mixture into a kneader and kneading the mixture into a paste.

30. The method of Claim 29, wherein the paste is degassed under vacuum.

31. The method of Claim 29, wherein the paste is extruded through a die to form a green article.

32. The method of Claim 29, wherein the water-solid-ratio of the paste is between about 0.4 to 1.2.

33. The method of Claim 31, comprising precuring the mixture for a predetermined period of time.

34. The method of Claim 31, further comprising autoclaving the green article.

35. In a method for extruding a cementitious article, the improvement comprising adding a quantity of low density calcium silicate hydrate to a formulation used to produce the article sufficient to accelerate the curing of the cementitious article as compared to an equivalent formulation made without low density calcium silicate hydrate.

36. In a method for forming a cementitious article, the improvement comprising adding a quantity of low density calcium silicate hydrate to a formulation used to produce the article sufficient to accelerate the curing of the cementitious article compared to an equivalent formulation made without low density calcium silicate hydrate.

37. An accelerated-curing cementitious formulation comprising:

a cementitious binder;

an aggregate; and

a low-density calcium silicate hydrate accelerant selected to reduce the curing time of the formulation, wherein the low-density calcium silicate hydrate is added in a quantity sufficient to reduce the curing time of the formulation compared to an equivalent formulation made without low density calcium silicate hydrate.

38. The formulation of Claim 37, wherein the low-density calcium silicate hydrate accelerant has a bulk density of between about 0.015 g/cm³ and 1.5 g/cm³.

39. The formulation of Claim 37, comprising a quantity of the low-density calcium silicate hydrate accelerant sufficient to accelerate the curing of the formulation by about 10% or more compared to an equivalent formulation without low-density calcium silicate hydrate.

40. The formulation of Claim 37, comprising a quantity of the low-density calcium silicate hydrate accelerant sufficient to accelerate the curing of the formulation by about 50% or more compared to an equivalent formulation without low-density calcium silicate hydrate.

41. The formulation of Claim 37, comprising sufficient low-density calcium silicate hydrate accelerant to produce a product of density between about 0.6 g/cm³ and 1.2 g/cm³ wherein the strength-to-weight ratio of the product is higher compared to an equivalent product without low-density calcium silicate hydrate.

42. The formulation of Claim 41, wherein the formulation is used to make articles for building and construction applications.

43. The formulation of Claim 41, wherein the formulation is used in the Hatschek process.

44. The formulation of Claim 43, further comprising between about 5% and 15% cellulose fibers.

45. The formulation of Claim 43, comprising between about 0.5% and 15% low-density calcium silicate hydrate.

46. The formulation of Claim 43, comprising between about 25% and 50% Portland cement.

47. The formulation of Claim 43, comprising between about 25% and 50% silica.
48. The formulation of Claim 43, wherein the silica is ground to about 200-mesh.
49. The formulation of Claim 43, wherein the aggregate is silica, and further comprising between about 0% and 40% of an additional aggregate.
50. The formulation of Claim 49, wherein the additional aggregate is a siliceous aggregate.
51. The formulation of Claim 50, wherein the additional aggregate is selected from the group consisting of cenospheres, perlite, vermiculite, volcanic ash, fly ash and bottom ash.
52. The formulation of Claim 43, further comprising between about 0% and 5% additives.
53. The formulation of Claim 52, wherein the additives are selected from the group consisting of alumina, pigments, colorants, flocculants, drainage aids, silicone materials, clays, mica, wollastonite, calcium carbonate and fire retardants.
54. The formulation of Claim 37, wherein the formulation is made into an extrudable paste.
55. The formulation of Claim 54, comprising between about 2% and 20% low-density calcium silicate hydrate.
56. The formulation of Claim 54, comprising between about 5% and 15% low-density calcium silicate hydrate.
57. The formulation of Claim 54, comprising sufficient low-density calcium silicate hydrate accelerant to reduce post-die swelling to less than about 6.5% as measured by increase in cross-sectional area.
58. The formulation of Claim 54, comprising between about 15% and 60% Portland cement.
59. The formulation of Claim 54, comprising between about 0% and 60% silica.
60. The formulation of Claim 59, wherein the silica is 200-mesh ground silica.
61. The formulation of Claim 54, wherein the aggregate is silica, and further comprising between about 0% and 40% of an additional aggregate.

62. The formulation of Claim 61, wherein the additional aggregate is a siliceous aggregate.

63. The formulation of Claim 62, wherein the siliceous aggregate is selected from the group consisting of cenospheres, perlite, vermiculite, volcanic ash, fly ash and bottom ash.

64. The formulation of Claim 62, wherein the siliceous aggregate has a particle size between about 50 and 250 microns.

65. The formulation of Claim 54, further comprising between about 0% and 15% fibers.

66. The formulation of Claim 65, wherein the fibers are cellulose.

67. The formulation of Claim 65, wherein the fibers are synthetic.

68. The formulation of Claim 54, further comprising between about 0% and 2% additives.

69. The formulation of Claim 68, wherein the additives are selected from the group consisting of alumina, pigments, colorants, surfactants, silicone materials, clays, mica, wollastonite, calcium carbonate and fire retardants.

70. The formulation of Claim 54, further comprising between about 0.2% and 3% of a viscosity enhancing agent.

71. The formulation of Claim 70, wherein the viscosity enhancing agent is selected from the group consisting of methylcellulose, hydroxyethylcellulose, hydroxyethylmethylcellulose and hydroxypropylmethylcellulose.

72. The formulation of Claim 54, further comprising between about 0% and 2% of a water reducing agent.

73. The formulation of Claim 54, further comprising between about 0% and 1% of an aeration agent.

74. The formulation of Claim 37, wherein the formulation is used to make concrete.

75. The formulation of Claim 74, comprising between about 0.5% and 20% low-density calcium silicate hydrate.

76. The formulation of Claim 74, comprising a quantity of the low-density calcium silicate hydrate accelerant sufficient to accelerate the curing of the formulation by at least about 65% compared to an equivalent formulation without low-density calcium silicate hydrate.

77. The formulation of Claim 74, comprising between about 15% and 50% Portland cement.

78. The formulation of Claim 74, comprising between about 0% and 70% silica.

79. The formulation of Claim 78, wherein the silica is quartz sand.

80. The formulation of Claim 79, wherein the quartz sand has a particle size of about 100 to 400 microns.

81. The formulation of Claim 74, wherein the aggregate is silica, and further comprising between about 0% and 40% of an additional aggregate.

82. The formulation of Claim 81, wherein the additional aggregate is a siliceous aggregate.

83. The formulation of Claim 82, wherein the siliceous aggregate is selected from the group consisting of natural rock, sand, gravel, limestone and bottom ash..

84. The formulation of Claim 74, further comprising between about 0% and 15% fiber reinforcement.

85. The formulation of Claim 84, wherein the fiber reinforcement is selected from the group consisting of steel wire, steel rods, synthetic polymer -fiber and carbon fiber.

86. The formulation of Claim 74, further comprising between about 0% and 2% additives.

87. The formulation of Claim 86, wherein the additives include a viscosity enhancing agent.

88. The formulation of Claim 87, wherein the viscosity enhancing agent is selected from the group consisting of methylcellulose, hydroxyethylcellulose, hydroxyethylmethylcellulose and hydroxypropylmethylcellulose.

89. The formulation of Claim 74, further comprising between about 0% and 0.2% of a leveling agent.

90. The formulation of Claim 74, further comprising between about 0% and 2% of a water reducing agent.

91. The formulation of Claim 74, further comprising between about 0% and 1% of an aeration agent.

92. The formulation of Claim 74, further comprising water, and wherein the water-to-cement ratio in the formulation is between about 0.35 and 1.